ELECTRICAL INJURIES

CHARLES A. LAUFFER M.D.

The above figure illustrates the three essential points in artificial respiration by the Prone Pressure method:
(1) The patient's position. (2) The operator's position.
(3) The position of the operator's hands. [*See p. 29.*]

ELECTRICAL INJURIES

THEIR CAUSATION, PREVENTION AND TREATMENT

DESIGNED FOR THE USE OF PRACTICAL ELECTRICAL MEN

BY

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PREFACE

The managements of our American railroads, and many industrial establishments, provide for the instruction of employees in first aid, and in the avoidance of perils incident to their work. This movement merits our most cordial approval; preventive clinics likewise are both philanthropic and economically profitable to large employers, and are at the same time a sure index to the employee himself that his physical welfare is being safeguarded.

The policy of the Company with which the author is connected provides for the instruction of employees in the theory and practice in the art of artificial respiration. By prompt action at resuscitation many lives have been saved; a number of the thousand men I have instructed have rendered efficient service in these emergencies.

Scores of employers in the electrical field have sent inquiries, and instruction cards have been sent out to power plants and central stations far and near. Great interest has been man-

ifested by electrical men everywhere, in the way of precautions leading to prevention of these accidents, and particularly in the way of preparing themselves so as to render effectual aid to comrades in electrical shock.

This intelligent interest among employers and employees, in the mutual efforts to avoid these tragic electrical deaths, augurs well for the eventual industrial triumph of electricity, as a human agency fully as safe as gas or water.

With the sincerest appreciation of the continual courtesies accorded me by electrical men in these inquiries, these pages are submitted to a generous public.

Charles A. Lauffer, M.D.

Wilkinsburg (Pittsburgh), Pa.,
April 1, 1912.

CONTENTS

ELECTRICAL INJURIES[1]

The usual injuries encountered in the industrial application of electricity are due to exposure to either flashes or actual contact.

Causation of Flash Injuries

Flashes, or arcs, occur upon breaking or momentarily short-circuiting direct and alternating current, as, for example, where a switch in a heavily loaded circuit is opened by mistake; where wires with deficient insulation become

[1] See similar articles by the same author in *The Electric Journal*, Vol. VIII, Nos. 2 and 8. *The Medical World*, July, 1911. *The Central Station*, September, 1911; *Human Engineering*, Vol. I, No. 4.

This paper was originally presented before The Westinghouse Club of Wilkinsburg (Pittsburgh) lecture season of 1910. From its nature, it required the co-operative efforts of an electrical man and a medical man. Special acknowledgments are due Mr. E. R. Spencer, Assistant Editor of *The Electric Journal*, for assistance rendered; also to J. W. Elliott and F. S. Peterkin for their comments

crossed; or where a workman at a switchboard allows his screwdriver to slip, causing a short circuit. There are a score of ways that will cause a sheet of flame to issue forth, surprising even the experienced.

Such is the origin of the mild flashes ordinarily observed and readily amenable to treatment; then there are the severe burns due to flashes from high voltage conductors.

With a voltage much in excess of 15,000, a man seldom makes contact with the conductor, for the voltage jumps over to his fingers, flexing them and making it impossible to make contact, unless he is thrown upon it. It takes a man a perceptible interval of time to approach the conductor, but the discharge is instantaneous.

The flexor muscles are so much stronger than the extensors, that the man is rolled up and violently precipitated. The discharge that bridges the interval between the circuit and its victim may cause extensive surface burns, and to the extent that it spends its force on the surface, there is diminished liability of serious electrical shock.

and constructive criticisms; and to other electrical men for their suggestions and helpful criticisms.

This work is as yet fragmentary; it is in the constructive stage; suggestions and comments, by way of addition or by way of subtraction, are invited by the author from all interested in this endeavor to outline the essential facts of electrical injuries.

The man approaching the high voltage conductor sinks as if shot when the discharge hits him; although the conditions may be such that he will receive a heavy current, the discharge may, more fortunately, carry with it only a small current, yet enough to flex his arm and leg muscles violently, and cause him to fall "all over himself." Such precipitation assists in extricating him from what might be a dangerous contact. In case of low voltage, if the hand grasps the conductor, the excessive electrical stimulation of his muscles causes his grip to tighten. His fingers flex tetanically. If unassisted, he is often unable to release his hold.

Prevention of Electrical Flashes

Careful attention in handling switches and plugs is imperative. Circuits should be open whenever practicable during tests and in repair work, and danger signs erected, as well as isolating the test by means of ropes. In the repairing of transmission lines and transformers connected thereto, the lines should be thoroughly grounded at the point of repair on any side from which power might be accidentally thrown on. Attention to such details as every electrical man knows, but sometimes ignores, will do much to minimize the number of these injuries. With sleeves rolled up to the elbows, and the face near a

switch when it is opened on a circuit carrying a heavy load, the exposure to flash burns is unnecessarily increased.

Great caution should be observed in approaching live high voltage conductors, and a safe distance maintained. The high voltage has even been known to jump some distance from switchboards, envelop a man in its flaming discharge, seriously burn him, and violently throw him down. High voltage should never be disregarded under any circumstances. It should be respected.

While the arcing distances for different voltages are given in every standard electrical handbook, there are surges in the high voltage, and from this abnormal voltage there may be an arcing to a greater distance than is ordinarily anticipated. The air resistance once broken down, the flaming arc may carry with it considerable current to the man who has ventured too near.

The Fire Underwriters have formulated rules covering the property hazard; the life hazard surely demands more adequate consideration from electrical experts.

Pathology of Flash Injuries

Although electrical flashes are of momentary duration, the heat developed is often very great.

This great heat produces painful burns on the unprotected skin and eyes, the burns are generally of the second degree, but flashes from high voltage may be of the third degree, as well as second.

Continued exposure to the rays of the electric arc as used in welding, though the operator may not have been near enough to feel any intensity of heat, may give rise to similar burns. Such burns usually do not become apparent until several hours after the exposure, and are of the first and second degree.

The eyes can be flashed by the welding arc at a considerable distance. The welders necessarily wear red and blue glasses in their helmets to protect them from this high intensity light. The fire of the flash that singes the hair or burns the skin is but one element in the production of flashed eyes; the effect is due to the actinic, or ultraviolet, rays present in the electric arc.

Symptoms of Flashed Eyes

Eyes which have been exposed to electrical flashes become very red, due to the sudden dilatation and congestion of the blood vessels of the mucous membrane lining the lids and in part covering the eyeball, known as the conjunctiva. Such an inflammation constitutes conjunctivitis. The pain is intense, there is an aversion to light, and a copious secretion of tears.

Often the eyelashes and eyebrows are singed, and charred hair, skin debris and dust particles may fill the eyes, contributing to the severity of the above symptoms.

In the more severe cases, a zone of red may appear around the cornea. The cornea is the central transparent area of the anterior wall of the eyeball; under it lies the iris, the colored part of the eye. Such a zone of red in the white of the eye, near its junction with the cornea, is a symptom of iritis, an evidence of an inflammation of the iris and other structures of the interior of the eyeball.

If the heat of the flash is sufficient, as in the more severe cases, the superficial layers of the transparent cornea are coagulated.

Treatment of Flashed Eyes

The immediate treatment consists in washing the region of the eye and eyelids with eye-water,[2] then washing the eye itself. Upon dropping into the eyes a sufficient quantity of three per cent cocaine hydrochloride solution,

[2] A serviceable formula for eye-water is as follows:

℞	Sodii biboric	0.30
	Acidi boric	0.15
	Alumini sulphatis	0.06
	Zinci sulphatis	0.06
	Aquae camphorae	30.00

M. Sig.—Use freely as an eye-wash.

the debris may be mopped out with clean cotton wrapped on a toothpick. The coagulated tissue of the cornea is similarly mopped off.

The immediate relief of pain is secured by cold compresses over the eyes, and the chief remedy in the subsequent treatment is cold compresses—merely cotton or a clean cloth laid on ice, or made wet in ice water, and changed by the patient every two minutes. The cold compresses serve to contract the dilated blood vessels, and thus control the painful congestion. They can be employed for an hour at a time, as the patient lies down; not constantly, but every other hour. This enables the patient to get some sleep, for flashed eyes are most painful when he is relaxed and ready to sleep. Eye-water is used every hour. The eye-water causes no relief of pain as does the cold compresses, but it shortens the term of disability. In severe cases adrenalin hydrochloride, 1 : 5000 solution, is used every half-hour; and atropine sulphate, one per cent solution is used, a few drops every four hours to control iritis, if this symptom manifests itself. Also it may be necessary to apply castor-oil every two hours to prevent the eyelids and eyeballs from growing together (synechial adhesion) if the corneal tissue has been much injured. In the milder flashes the three latter remedies are omitted, as the patient wears smoked glasses and returns to work in two or three days.

It is conceivable that high intensity flashes are capable of seriously affecting the optic nerves in susceptible cases, though such a case has never come under our observation. Recovery is prompt and complete in practically all cases.

Symptoms of Flashed Skin

Flash burns of the skin are usually burns of the second degree. That is to say, while destroying the outer layer of the skin (the epithelium) they do not injure the inner layer of the skin (the corium) nor the deeper tissues. At first these burns may present a mere congestion; the skin is red, as from exposure to the sun, and they have the appearance of first degree burns, scarce worth while dressing and bandaging. But there is pain, some redness, and by the second day huge blebs, or blisters, may have formed. Usually the hair is scorched; sometimes the outer skin is blown off, and the surface looks ragged. Under proper treatment of these cases there is seldom any formation of pus, and they will heal up, usually without leaving a scar. We have treated many such burns with the happiest results. We have treated men whose features were so altered by burns and the eyes so swollen shut, that their own mothers would not have known them. To the uninitiated it seemed they were scarred for life, yet within

two weeks they were able to resume work, and within two months no trace of their burns were discernible.

Treatment of Flash Burns of the Skin

The immediate treatment of flash burns consists in securing the highest obtainable degree of surgical cleanliness with ethereal soap [1] applied with numerous cotton sponges (using sterilized absorbent cotton such as is sold for medical use) and the application of sterile gauze dressing, well covered with Unguentine. We find this ointment uniformly reliable; it soothes the pain and promotes recovery. A loose gauze bandage is applied and the part put at rest.

The subsequent treatment consists of daily redressings. When the blebs are large, we scissors them open freely, but allow the outer skin to remain for some days, as it is in itself a splendid protective covering.

[1] A good formula for ethereal soap, that dissolves and removes the dirt and grime and at the same time renders the area antiseptic, consists of:

Sulphuric ether	4 oz.
Turpentine	1 oz.
Alcohol	3 pts.
Surgical soft soap	4 lbs.
Water, enough to make	1 gal.

If denatured alcohol is used, the price of it is correspondingly reduced.

A burn must be washed clean, then there is little liability to infection with its pain, the formation of pus, and the resulting long term of disability. But should it become infected and pus form, we at once trim away the dead skin, so as to allow no pockets for the retention of infection. In the absence of infection, that is, when the pus-producing bacteria do not invade the wound, the dead skin is removed within a few days, after the inner sensitive layer of the skin has had a chance to harden somewhat, and to lose its hypersensitiveness. At this stage Scarlet Salve accelerates recovery. When the healing has progressed we sometimes apply ten per cent Ichthyol in Petrolatum, to facilitate the formation of normal skin. After recovery, in most cases, the skin remains red and sensitive for some weeks. We instruct the patient to wear canvas gloves and otherwise protect the new skin from grime and weather, as it is prone to eczema.

The dry, open method of treating such burns, namely, that of powdering on stearate of zinc freely and exposing them unbandaged to the air, is more or less successful in hospital practice, but not adapted to ambulatory patients, especially those that may live on the streets and in dirty houses, and who may return to work before complete recovery.

Symptoms of Flashes from High Voltages

In contrast to the usual benign burns from low voltage is the severe burning from high voltage flashes, causing destruction to all layers of the skin (third degree burns) over large areas. Great mental excitation, even transient mania, is sometimes observed in these cases; again, on the contrary, some patients are relaxed, unconscious, not breathing, and may require immediate resuscitation by artificial respiration.

Treatment of High Voltage Flashes

These are hospital cases, and they may require much care to ensure their recovery. Delirium is sometimes encountered. Where large areas are burned there is increased danger from sepsis. When convalescence is established, skin deficiencies are restored by grafting. In such cases the recovery is slow. Scarring will be more or less extensive, depending on the depth and extent of the burns and the infection that may be associated.

Contact Injuries

The two types of contact injuries are shocks and burns. The passage of an electric current through the human body may cause a momentary unpleasantness, the retention of the victim within

the circuit unable to release himself, a suspension of consciousness, during which he falls, but revives again, or a suspension of animation, requiring artificial respiration.

Factors in Causation of Contact Burns, and Serious Shock

There is a wide variety of external and individual conditions that influence the extent of electrical injury, and there is an interdependence of circumstances that make tabulated results and records of accidents apparently inconsistent. At one time 110 volts are involved, and there is a fatal accident; at another 15,000 and more and recovery will ensue. Individual susceptibility is a large factor, and the emotions play no inconsiderable role. For instance, in a case reported by Jellinek, a lineman died purely of fright on touching a high voltage line which was not charged at all.

While fright is an important element, it may not explain everything; when an unemotional healthy man meets a tragic death, it is with difficulty attributed to his imagination. A long distance high-tension transmission line disconnected from the scources of power may build up a high static voltage, due to the action of the atmosphere, even in dry weather. It is interesting to note that what appeared to be a Leyden jar, or static condenser, effect, has been observed

by an experienced practical electrical man with whom the writer is acquainted, where on one occasion, upon going to the rescue of a man who had been momentarily rendered unconscious as the result of an electrical shock, he received a discharge from the man's body, notwithstanding it was free from contact with the circuit which gave the shock. This rather unexpected phenomenon may possibly be accounted for by the fact that the ground, wood, cement or brick floor on which the body lies, may be too dry to carry off the high static charge which it has received, and the rescuer on grasping it may experience a rather heavy electrical "kick." While this experience is unusual, yet in the case of transformer coils, after high voltage tests, it is found they frequently contain a high static charge, which remains for many minutes after the apparatus is disconnected from the circuit.

Generally speaking, the higher the voltage involved, the greater will be the current through the body; the longer the duration of the contact and the larger the number of points of contact, the greater the danger to life. Yet the human body is a relatively poor conductor; its high resistance greatly reduces the amperage of the current. It is generally a shunted current that the man receives, a mere leakage from the line, from which he will often recover if properly resuscitated.

The voltage being equal, alternating current is probably less dangerous than direct current. With alternating current frequencies below 10,000 cycles, and equal voltage, more response is produced than in frequencies approaching 100,000 cycles per second. With A. C. frequency exceeding 10,000, as employed in electro-therapeutics, the current causes neither muscular contractions nor pain.

An interesting contribution on "The Physiological Tolerance of Alternating Current Strengths up to Frequencies of 100,000 Cycles per Second," by A. E. Kennelly and E. F. W. Alexander, reported in the *Electrical World*, for July 21, 1910, experimentally adduces these facts:

"A series of measurements was obtained on the same patient say, at five frequencies between 15,000 and 100,000 cycles, within an interval of about twenty minutes. The limiting current strength which the subject would take through his arms and body, without marked discomfort or distress, at any frequency, may be designated as the tolerance current for that subject and frequency.

"It was observed that the tolerance current increased from 0.03 amp. at 11,000 cycles per second to about 0.45 amp., or even 0.8 amp., at 100,000 cycles per second. This means that the tolerance cyclic quantity increases from about 2.5 microcoulombs per cycle at 11,000 cycles per

second to about 4.5 microcoulombs at 100,000 cycles per second.

"It was the unanimous testimony of all subjects experiencing the high-frequency current that at or near 100,000 cycles per second there was a sensation of tingling and heat in the wrists, when the tolerance current was approached, but no muscular contractions were produced, either in the hands or arms. When the frequency was reduced to about 50,000 cycles per second, muscular contractions commenced in the muscles of the forearms. As the frequency was reduced below 50,000 cycles per second, the muscular contractions became more evident."

High frequency currents, even though of high voltage, such for example as are produced by X-ray induction coils, and also that of the aerial side of wireless telegraph apparatus, are not ordinarily dangerous, on account of their tendency to seek the surface of conductors in their circuit rather than flow by way of internal path. This tendency gives rise to the term "skin effect."

While burns and electrical shock are often associated, it is noteworthy that in many cases of accidental electrocution there are no demonstrable burns.

The calloused palms of a workingman offer the highest electrical resistance. The epidermis (the outer layer of the skin) limits the amount of current a man receives from a circuit, because

the epidermis, containing no blood or lymph, is a poor conductor. It offers this high electrical resistance, provided the skin does not become moist through perspiration, or from other causes.

Tabulated figures on the electrical resistance of the human body varies greatly. For example, by the bridge method on the Baker Static Machine the hand to hand resistance on various individuals was found to be 40,000 ohms (min.) to 140,000 ohms (max.). Moistening the hands cuts the hand to hand resistance to 29,000 ohms; immersing the hands in water reduces it to 5400 ohms, and making the water conductive by the addition of salt, further reduces it to 4600 ohms.

We are so fortunate as to secure this information from H. E. Heath, Consulting Engineer, Baker Electric Company, New York City, through a communication for *The Electric Journal.* The definite electrical resistance of the human body, by the bridge method, is expressed in equivalent ohms. The surfaces are dry; six inches tinfoil contact.

	Min.	Max.
Forehead to neck (back)	3400 ohms	4000 ohms
Neck (back) to chest	5300 "	7500 "
" to right hand	14,000 "	60,000 "
" to left hand	26,800 "	55,000 "
" to both hands	10,850 "	35,000 "
" to hip	18,500 "	80,000 "
" to knee	120,000 "	170,000 "
Hand to hand	40,000 "	140,000 "
Hip to knee	47,000 "	165,000 "

While approximately 10 amps. of current may be involved in criminal electrocutions, with electrodes at base of brain and calf of legs, yet $\frac{1}{10}$ amp. may become dangerous under certain conditions of contact with D. C., or A. C. of low frequency, if maintained for any length of time, and $\frac{1}{2}$ amp. is considered prohibitive.

A current that is harmless at first, by breaking down the skin resistance and taking an internal path, may become dangerous.

Cases are recorded where the ordinary 110-volt 60-cycle lighting circuit proved dangerous. Should the insulation of the socket be defective, in the act of placing an incandescent lamp in the socket, or in turning on the light, a man may come in contact with the circuit and receive a current from the hand to both feet; if he is at the time in a bathtub, his hand being wet, and his feet in water, or even if he is standing on a damp grounded floor, the conditions of contact minimize the skin resistance. The shock may be such as to violently flex the muscles of his hands, and render him powerless to release himself. If unassisted, he may continue to receive current until death results. Again, in the presence of many circuits, with certain of them grounded, it is nearly impossible to determine from what source the voltage comes that causes the injury. The voltages may be increased or diminished in their resultant joint effects.

The location and number of contacts is an important factor, as well as the duration of the contact. " A small current applied over the pneumogastric nerve in the neck would paralyze the heart, whereas taken through the hands or body, the path must be over the nervous mechanism controlling the respiratory and cardiac centers to produce death." But it can be argued that the electric current follows the blood vessels, not the nerve trunks; oil is a non-conductor, the nerve trunks are chiefly fat. On the other hand, the saline constituents of the blood make it a good conductor.

In the study of drugs we find that what is an overdose of a certain drug for one individual is a remedial dose for another. This peculiar drug susceptibility we term idiosyncrasy; it is a peculiarity that cannot be accounted for. Similarly, in the passage of electric current through the human body, a quantity of current that would give serious shock in one individual would produce merely a tingling sensation in another.

The various external and individual circumstances that influence the extent of electrical injury, in the grouping of Dr. S. Jellinek, are: "1. External: (*a*) voltage, (*b*) amperes, (*c*) number of poles (points of contact), (*d*) time limit of contact, (*e*) the kind of current (A. C. or D. C.). 2. Individual: (*a*) resistance of skin and body, (*b*) the path of the current through the body, or

over the surface of the skin, (*c*) the condition of the mind and body."

Criminal Electrocutions [1]

In this connection it may be stated that in penal electrocutions, "the head, chest, arms and legs are secured by broad straps. An electrode, thoroughly moistened with saturated salt solution, is affixed to the head, another to the calf of the leg, both electrodes being so molded as to insure good contact.

"The contact is made with a high potential —1800 volts—for five to seven seconds, reduced to 200 to 250 volts until a half minute has elapsed; raised to high voltage for three to five seconds; again reduced to low voltage until one minute has elapsed, when it is again raised to the high voltage for a few seconds and the contact is broken. The ammeter usually shows that from 7 to 10 amps. have passed through the criminal's body. . . .

"At the moment the contact is made the criminal's body stiffens to a state of tonic muscular spasm, restrained by the straps. This spasm abates somewhat as the voltage is reduced, to again attain its maximum with each rise of

[1] The quotations are from the writings of Edward Anthony Spitzka, M.D., of Philadelphia, whose numerous post mortems on electrocuted criminals constitute him the leading American authority on Electrical Death.

voltage. When the current is interrupted, the body collapses completely. . . .

"The post mortem examination of electrocuted criminals reveals a number of interesting phenomena.

"The temperature of the body rises promptly and reaches as high as 120 to $129\frac{1}{2}°$ F., within twenty minutes in many cases. The development of this high temperature is to be regarded as resulting from the active metabolism of tissues not (somatically) dead within a body where all vital mechanisms have been abolished, there being no circulation to carry off the generated heat. The maximum of heat is generated at the site of the leg-electrodes, where muscle—myosin—coagulation is most extensive. Furthermore, the release of from 10 to 20 horse-power of energy within the body must contribute materially to the caloric increase.

"The heart, at first flaccid when exposed after death, soon contracts and assumes a tetanized condition. This is particularly marked in the left ventricle. On the whole the organ assumes the form of a heart in systole. . . . This contracted condition of the heart is doubtless due to the high electromotive force of the fatal current. The ventricles are found empty.

"The lungs are usually devoid of blood and weigh only seven or eight ounces avoirdupois each.

"The blood is profoundly altered biochemically. It is of a very dark brownish hue, and it rarely coagulates. Either the fibrinogen, or the fibrin ferment, or both, are destroyed.

"The maximum damage is undoubtedly wrought in the nerve system, though this is not always manifest. Regarding the histologic changes, reports from various sources differ. There is a general agreement as to the frequent occurrence of capillary hemorrhages, disruptive and destructive for adjacent tissues. In the nerve cells themselves there appears to be no apparent change, although there must have resulted terrific molecular changes. P. A. Fish found vacuoles in one case, but no visible changes in another. Aside from the capillary hemorrhages and the arterial anaemia with venous congestion, the brain shows no gross changes of appearance. In a case of accidental death from contact with an alternating current of 1000 volts for about one-half minute, Jellinek found extensive streaks of capillary hemorrhages in the gray substance of the brain and spinal cord, together with more or less destruction of the nerve cells, extension of the cell nucleus, etc."

In cases presenting such phenomena, no recovery is possible under any method of resuscitation. But the presumable condition present in the victim of electrical shock, viz., blood altered, veins altered and full of blood, arteries

nearly empty, heart feebly pulsating, respiration ceased—requires immediate artificial respiration.

Theories of Electrical Shock

Physiological experimentation on animals adduces the conclusion that in suspended animation (cessation of respiration and cardiac action) from electrical over-stimulation the brain loses its power to react to stimuli. This irritation (power to react) is only temporarily suspended, so that life, if not entirely extinct, is dependent on artificial respiration until such time as the brain (the control board of the central station plant) recovers its irritability. The action of the brain is like that of the dry battery of a common door bell, which, if rung too continuously, exhausts the battery so that the bell ceases ringing. Thus, if over-stimulated to the point of exhaustion, the brain suspends vital operation. The dry battery left to itself recovers, and the bell will ring again; the brain possesses infinitely greater power of recovery. But under the extreme condition resulting from electric shock artificial respiration must be employed to supply oxygen, so that oxygenated blood may help sustain the heart action, else there will be no interval of rest allowed the exhausted brain in which to recover. While

the irritability of the brain, which subsides immediately after the shock, will within a few minutes recover, everything depends finally, where artificial respiration is employed, on whether the action of the heart continues or not.

A second theory is that of asphyxiation, or the non-oxygenation of the blood. There is a heightened chemical activity (electrolysis) and accelerated metabolism from the current that induces the electrical shock and much carbon dioxide and other toxic products are produced. The excess of carbon dioxide in the blood paralyzes the respiratory center in the medulla, the physiological co-ordinating center of the brain. In asphyxia artificial respiration is required, and must be continued until the blood is oxygenated, before the normal respiratory function will be re-established.

A third theory makes electrical shock depend upon a sudden dilatation of the great vessels of the splanchnic area (those of the abdominal viscera). The blood vessels are held in a state of tonic constriction by nerves of the sympathetic nervous system. The shock is conveyed from the cerebro-spinal nervous system to the sympathetic nervous system. This tonic constriction of the splanchnic vessels is suddenly recalled and suppressed, and in a moment these vessels dilate to twice their normal diameter, able to contain four times the quantity of blood

normally contained, and the man in shock is accordingly liable to die of hemorrhage into his own blood vessels. Paradoxically, he can die of hemorrhage in this state without shedding a drop of blood.

Respiration will cease at once from anaemia of the medulla. The brain depends for its blood tension on the tonicity of the vessels of the splanchnic area. Not only will the brain be without blood, but the heart will have no blood to impel into the arteries, and unless artificial respiration is resorted to instantly the increasing asphyxia will speedily result fatally.

Breaking the Contact

The voltage may cause a rigid contraction of the flexor muscles, so that the victim cannot free himself from the accidental contact.

If there is a circuit breaker near at hand, cut off the current at once; if none, remove the body from the circuit by means of any dry non-conductor, such as a dry piece of wood, or a tool, such as a pick or shovel having a dry wooden handle. Either push or roll the body aside, or pull away the conductor. The rescuer can stand on a real dry wood or concrete floor and pull away the body from the conductor, without danger to himself; or he can catch the victim's clothing, or he can safely grasp the body of the

victim if his hands are protected by several thicknesses of dry cloth.

If other methods are impossible it may be possible to short-circuit the line with which the victim is in contact, and thus cause the circuit breaker to open the circuit, or blow the fuses which protect that part of the electric system. A short-circuit may be made by throwing a chain, a bar, or a piece of pipe across the two conductors of the circuit, so that the electric current will have a direct metallic path in preference to one through the body of the victim. In case the victim is in contact with a trolley wire, for example, a metal pipe, or a length of wire, should be placed firmly in contact with the track rail and then thrown across the trolley wire, so as to be in contact with both. In doing this great precaution must be observed; unless one end of the metal short-circuiting piece is very positively grounded it should leave the hand before it touches the current-carrying part of the circuit, as otherwise there is equal danger to the rescuer of being shocked. The safest procedure is to handle the metal piece with the hands thoroughly insulated from it.

This method is of course least dangerous in the case of low voltage, as with high voltage there is increased liability that an arc would form. The flame of the arc in this instance might seriously burn the person attempting to open

the line by short-circuiting, and might also further injure the person whose rescue was being sought. There is no need of being reckless in rescuing a comrade from an electric circuit. Rescue work must be done quickly but intelligently. To open the circuit by means of a nearby circuit breaker or switch, where practicable, is the surest way of getting the victim out of the circuit. Striking him with a block of wood, or pulling him off by his clothing, or otherwise, is less certain.

Resuscitation by Artificial Respiration [1]

The efforts at resuscitation must be begun the instant the patient is freed from the contact. Sixty seconds is too long for preliminaries. The comrade nearest him must know how to give artificial respiration, as loss of time in summoning a physician is unpardonable. The services of the latter are often essential in winning back the life, but the artificial respiration must be begun early, and perseveringly continued, if it is to be saved. Whether he be only apparently dead, or actually beyond all human aid cannot be predicted; we must help him to live.

While the heart beats there is hope. Artificial respiration helps sustain the cardiac action.

[1] See *The Journal of the American Medical Association*, Vol. LI, No. 10, and *Collier's*, Vol. XLI, No. 25, for articles on Resuscitation by the Prone Pressure (Schaefer) method.

Even when no radial wrist pulse is felt, the comrades are not justified in ceasing their efforts at resuscitation, as the heart may still be beating feebly. In the occasional cases where the heart action has ceased, as the physician upon his arrival may determine with his stethoscope, there will be no possibility of restoring the normal respiration by any method of artificial respiration. Yet the victim should have the benefit of any doubt, for there are few cases of electrical accident where the victim cannot be restored from the electrical shock, if appropriate immediate efforts at resuscitation are instituted.

Rules for Artificial Respiration

The three essentials of the Prone Pressure method of artificial respiration to be remembered and practiced in anticipation of an emergency are as follows:

I. The man is laid upon his stomach, face turned to one side, so that the mouth and nose do not touch the ground.

II. The operator kneels, straddling the patient's hips, or kneels by either side of the hips, facing the patient's head.

III. The operator places his spread hands upon the lower ribs of the patient and throws his body and shoulders forward, so as to bring his weight heavily upon the lower ribs of the patient.

The operator's downward pressure should occupy about three seconds, then his hands are suddenly released. It is well to remove the hands entirely.

The pressure should be begun light, and increased gradually up to the end of the three seconds; the pressure should be uniform in each act, and the rate uniform, as sudden thrusts and irregularity in speed too little resemble natural respiration. The operator's arms should be straight, not bent at the elbows, and the weight should come from the shoulders. Pressure on the ribs is made with the heel of the hand (the thenar and hypothenar eminence).

This act should be repeated an indefinite number of times at the rate of twelve times a minute. In the excitement of the occasion the danger is that the rate will exceed sixteen times a minute; fourteen is a good average. If the operator is alone with the patient he can adjust the rate of giving artificial respiration by his own deep, regular breathing; if more persons are present, a watch can be used to advantage to regulate the rate.

The abdomen is pressed against the ground and the diaphragm is thereby pushed up by the viscera (liver, spleen, etc.). This empties the lungs of air and on the release of pressure, the resiliency of the chest walls creates a partial vacuum, causing the lungs to be refilled with

fresh air; the operation is analogous to the action of a bellows.

By spreading the fingers over the lowest ribs, one gets a certain amount of pressure upon the lowest part of the chest, which helps a little; though "the efficacy of the method depends mainly upon abdominal pressure."

Any evidence of returning animation should encourage the operator to continue his efforts. It often requires one-half hour to two hours. In electrical shock seldom over one-half hour is required, but in cases of drowning, especially, it is advisable to keep at it, for recoveries are alleged to have resulted after three hours of continuous artificial respiration. This same method is applicable for asphyxiation from whatever cause.

The four points to be especially remembered in connection with the Prone Pressure method are:

I. Position of the patient.

II. Posture of the operator.

III. The mode of operation.

IV. Rate per minute, and duration of operation.

Supplemental Efforts

If the operator is alone with the patient, the artificial respiration is his chief concern, and offers the only hope for the victim. Yet if others are present they may keep back the crowd, loosen

tight neckbands, if any, and hold a cloth saturated with Aromatic Spirits of Ammonia near the nose. As a respiratory stimulant it is even more useful than oxygen, yet is valuable only as an adjunct to the artificial respiration.

The physician upon his arrival, should the respiratory function continue in abeyance, may render great assistance by the hypodermic administration of Atropin Sulph. gr. $\frac{1}{100}$ and Strychnin Sulph. gr. $\frac{1}{30}$, which can be repeated at his discretion, or he can stretch the sphincter ani.

Injudicious assistance is often harmful. No liquids should be given by the mouth to an unconscious patient. Under conditions met with in electrical shock, and in those near drowned, liquids given are more liable to enter the lungs than the stomach.

When the rhythm of the respiration is re-established and consciousness is restored, the patient may experience thirst and may be encouraged to drink a teaspoonful of aromatic spirits of ammonia in one-half glass of water, and the same repeated after a short interval. He may be cold and weak and in that case will require blankets and artificial heat; or he may be strong as ever, in which case it helps to wake him up to allow him to walk with assistance a reasonable distance to the physician to have his accompanying burns dressed.

Yet a word of caution is here necessary. When artificial respiration has succeeded and the patient is recovering from the electrical shock, he may be excited and may desire to stand up too soon. He must be dissuaded from doing so until fully out of the shock—his heart and breathing fully restored—before he is permitted to sit up, and finally stand up. He needs watching for some time. If he gets up too soon a second effort at artificial respiration may be unavailing; it may be the collapse of heart failure.

Advantages of the Prone Pressure Method

The Prone Pressure method is best because: (1) It is easy to learn. Any intelligent man may be instructed in a few minutes and can practice on his friends, and they on him, until he becomes an expert in the art of giving artificial respiration. (2) It requires no apparatus. There is no delay in waiting until an emergency outfit is found. (3) It can be carried on easily by one person. A mere boy of twelve can resuscitate an overweight adult and maintain sufficient inflow and outflow of air (tidal air), as much as he would secure were he able to breathe voluntarily. One operator can work without exhaustion for an unlimited length of time by this method; there is no need of team work, and teams working in relays, as for example with the Sylvester-

Laborde method. Hence, there is diminished temptation to quit too soon. (4) Spirometer tests show the Prone Pressure method superior in the amount of tidal air handled, as exhibited by Prof. E. A. Schaefer of Edinburgh before the American Medical Association. (5) It is the method that best meets the complications of suspended animation as encountered in electrical shock: (*a*) In the usual excessive relaxation of electrical shock, there is great liability of swallowing the tongue with the patient on the back, and considerable difficulty in holding it forward; by the Prone Pressure method, with the man on his abdomen, the tongue falls forward of its own weight. (*b*) In the frequent bronchorrhea (excessive secretion from the air-passages) and edema of the lungs (leakage of blood-stained serum into air-vesicles) by laying the man prone on his stomach, these secretions run out of the mouth, and there is no danger of drowning the man in his own secretions. By the older method, where this complication was successfully met, the patient had to be rolled on his stomach occasionally to permit of the escape of bloody mucus, then rolled on his back, and the secretions churned up in his lungs until the artificial respirations were another time interrupted by rolling him on his abdomen to let the secretions escape from his mouth. (*c*) In cases of electrical shock presenting muscular rigidity there may be a

continuous contraction of the muscles, tetanic in character; his arms cannot be manipulated. By pressure on the ribs, according to the Prone Pressure method, and simultaneous pressure on the abdomen by a second comrade, mucus is expelled from the mouth in a brief period, and with the first forced expiration there comes a general muscular relaxation, and continued artificial respiration leads to recovery. (6) With the patient on his back, a folded coat under his shoulders, his head is too much lowered, when the Sylvester-Laborde method is employed. Spitzka raises the head, not the shoulders, and does not manipulate the arms, so as to diminish the tendency to any increase of hemorrhages in the brain and cord. Spitzka places the victim of electrical shock on his back, and relies upon rhythmic abdominal pressure as a mode of artificial respiration, in a manner quite analogous to the Prone Pressure method, yet that method requires a tongue forceps in the hands of a second person.

Symptoms of Contact Burns

The burns from electrical contact are generally of the third degree; that is, there is a destruction of both layers of the skin, and even of deeper tissues. The real extent is not immediately apparent. The tissues are coagulated, and there

is a deep white slough that is slow in separating. At times, fingers are burned to a cinder, or the vascular supply so destroyed as to cause a dry gangrene. These burns are as a rule painless, and upon recovering from the shock the patient may not consider himself burned, but later the discovery is made. In the milder forms they may not report for treatment until some days after the accident, by which time the burn has become infected. But these burns are worse than they look and are obstinate to heal, especially after infection sets in. Ordinarily, in the milder cases, the patient is best treated while continuing at work. In the severer degrees, as above mentioned, they are hospital cases.

Treatment of Contact Burns

The immediate treatment of such burns consists in surgical cleanliness, secured by ethereal soap applied by numerous sponges. For the milder burns, we prefer Deplettol, or 10 per cent Ichthyol on sterile gauze, to facilitate the separation of necrosed (dead) tissues. When the slough has separated, we commonly employ Balsam of Peru as a dressing, and alternate with Thymol Iodide at times. When crusts form under this mode of treatment, we employ Zinc Oxide ointment, to remove them, and continue the

daily dressings until the defect has granulated in and the area is covered with healthy skin.

The severer burns in hospital practice are treated by open, dry or wet methods, in accordance with the ideas of the surgeon on the particular service. It is customary to be conservative in waiting for gangrene to demark the necrosed tissues, rather than to resort to immediate amputations, inasmuch as the boundaries of the damaged tissues cannot be immediately determined. Burns of the palms, which to the uninitiated may seem trivial, may necessitate the amputation of the hands, due to necrosis of the tendons.

Forethought

Suspended animation requires instant relief, yet so often many who have been trained to give artificial respiration are helpless in such an emergency. Many are excited, frenzied. All turn white. Some jump up and down, others scream, and are incapable of intelligent action. With deliberate, prudent forethought, akin to the German Bureau of Strategy, each individual must study out in advance just what he would do under given circumstances—if his home or factory were on fire, or a comrade were on an electric circuit. Every action must be carefully

thought out in advance. Testers should know if the floor is a non-conductor, and should know the location of switches that may be opened, or the methods of pulling a man off by his clothing, or otherwise, in such manner that the rescuer is safe. Then he must previously study out and know how to give artificial respiration, so that there will be nothing unforeseen, nothing unanticipated, in an apparent calamity that spreads consternation particularly among those not qualified to meet the responsibilities of the situation.

Are Too Many Deaths Attributed to Electricity?

It should be remembered that panic (the emotions), causing great vascular dilatation from slight injury, as before related, and subsequent failure to perform artificial respiration, probably accounts for many deaths attributed to electricity, in cases where life could be saved by any good method of resuscitation. Deaths under these circumstances are due to neglect; the resuscitation is delayed, improperly conducted, or discontinued too soon. The electrolytic action of the current on the man's blood has produced too much carbon dioxide. As he is being rapidly asphyxiated by it he will die, unless assisted by artificial respiration.

Does artificial respiration save life? An electrician in our plant within six years in his own department has rescued six from death's door; six out of six, a record of 100 per cent saved. He is there within three seconds, and begins the artificial respiration in the spot where they fall, and keeps by them in that spot until they have fully recovered. He is enthusiastic for the Prone Pressure method.

This outline sketch of electrical injuries is designed to emphasize the curability of this type of accidents, if skilfully handled, not to encourage patients to try to treat themselves. Yet it is designed to insist that everybody, especially electrical men, learn how to give artificial respiration by the Prone Pressure method, with the purpose of minimizing the number of fatalities from electrical shock.

While pulmotors—the automatic oxygen pulmotor (Draeger) is splendid for the gas asphyxia of mines—for pumping air into the lungs and out of them, and electrical devices for stimulating cardiac and respiratory action are on the market, yet these and other appliances can never wholly supersede manual methods of resuscitation. Whatever in the way of equipment may some day merit general adoption, we know that no reliance can be placed on any outfit that cannot be carried with every electrical workman, and that is not instantly available. We know that

success in artificial respiration is attained by the Prone Pressure method, and by other methods. Indeed, ignorance of a method of resuscitating a comrade is criminal negligence on the part of any man of normal intelligence and conscience.

MINOR SURGERY AND FIRST AID

A WOUND is a breach of the skin and flesh; it is an incised wound when the skin is severed by a cutting instrument, such as a knife; a lacerated wound when made by a blunt instrument, with rough uneven outlines, accompanied often with much bruising (contusion) of the tissues; a puncture wound when from a sharp instrument, as in tramping on a nail, receiving a stab with a knife, or a bullet wound, characterized by great depth and limited surface injury.

The danger of a wound depends upon the structures severed or penetrated; veins and arteries may be opened, nerves and tendons severed (requiring accurate approximation and suturing), or organs penetrated, as brain, lungs, liver, intestines, etc. External appearances often give very meagre indications of the damage inflicted.

For complete recovery of function, bone must be reunited to bone, tendon sutured to tendon, nerve to nerve, muscle to muscle, skin to skin.

The slightest wounds, miniature abrasions of the skin, may give rise to dangerous infections by the entrance of infectious bacteria. When

infection sets in there may be an area of swelling and redness about the wound, and a red line (ascending lymphangitis) leading upwards to the nearest lymph node. Pain, heat, pulsation develop in the wound, and there may be some rise of temperature above the normal 98.6 degrees. Such is the incipient state of "blood-poisoning."

Infected wounds require the skilful attention of a physician, and the employment of such antiseptic remedies as will destroy and reduce in virulence the invading bacteria, thereby controlling and eliminating the infection, with the least injury to the tissues of the patient.

Treatment. Very slight abrasions may be painted with Tincture Iodine; wrap cotton on toothpick, immerse it in the Tincture Iodine, and paint the site of the abrasion.

Where the injury is larger than a pin prick, it is prudent to seek the services of some physician competent to give suitable attention to the injury.

The area about the injury should be thoroughly cleaned with ethereal soap, and turpentine, benzine, or other detergent employed to remove any special grime, then with hands thoroughly cleaned, the wound itself is cleaned, using many changes of cotton mops saturated with surgical soap. Often a knife, currette and forceps are required to scrape out foreign materials in the wound. The hair must be shaved away, and

the infecting bacteria reduced in quantity, and their virulence so far as possible impaired by agents that will destroy bacteria without devitalizing the tissues of the patient. For this purpose Tincture Iodine and Lugol's Solution are probably the best, for mopping out the wound before applying sterile dressings.

Hemorrhage from a wound is a good thing; the blood is clean; it aids in cleansing the wound, and is a perfect dressing for the wound, after it has been properly cleansed by scrubbing and scraping. Blood coming in squirts is arterial blood; if in a steady stream it is venous blood; when oozing from a wound it is capillary blood. Do not try to stop the flow of blood unless it is very severe. A pad of sterile gauze over the seat of the hemorrhage and a bandage applied will stop severe venous and capillary hemorrhage; a handkerchief or suspender, or a few turns of bandage, above the elbow or knee—a stick inserted under it, and twisted—will stop bleeding anywhere below the elbow or below the knee. However, no form of tourniquet should be employed before the patient is taken to the physician, unless absolutely needed. Let the physician or his trained assistants wash the wound, if they are to be responsible for it; dirt can be washed into the wound as well as out of it, and incalculable damage may be done by meddlesome first aid interference.

Burns due to heat, steam, electricity, chemicals—can be covered at once with cotton soaked in Carron Oil for the relief of pain until properly washed; they require skilled attendance.

Fractures, where there is complete separation of the fragments, require careful handling of the part; a light board or an umbrella can be improvised as a temporary splint for a broken leg, or this can be dispensed with, if the patient is laid carefully on a stretcher and carried at once to the doctor's office. Careless handling may cause the jagged fragments of bone to penetrate the superimposed muscles, nerves, and blood-vessels, or puncture the skin (converting a simple fracture into a compound fracture), producing alarming and perhaps serious complications.

Fractures, dislocations, sprains are best differentiated by the physician; where deformity and other symptoms are marked, it is a clear case, but at other times the aid of the X-ray is desirable for the sake of certainty of diagnosis.

Asphyxia from drowning, gas-poisoning, opium-poisoning, etc., can be relieved by artificial respiration, by the Prone Pressure method, as described in the foregoing chapter.

A disposition to fainting, and many cases of dizziness, headache, sick stomach, are relieved by giving one teaspoonful of aromatic spirits of ammonia in one-half glass of water. When a person seated in a chair has fainted, prompt

relief is assured by bending his head forward between his knees for a few moments; or by laying the patient on his back, on the floor where he has fallen, exercising care that the head be lower than the heels.

INFECTIONS

All nature, where inhabited by man, is infested with low forms of vegetable life, some of which are dangerous to man, others beneficial to him. These micro-organisms are known as bacteria; they are the minutest and most hardy of the plants. They are so small that a millimeter has to be divided into one thousand parts, constituting a micron, for measuring them. Their study began practically with the invention of the oil immersion microscope, as magnification of one thousand diameters is essential for their accurate observation. The problem of special media for growing them and special chemical stains for coloring and discoloring them, has developed into an exact science, the branch of biochemistry known as bacteriology. So small are some of these little plants that four hundred millions of them will be no larger than a grain of granulated sugar. So rapidly do they multiply that there is a new generation every half hour; they multiply by each dividing into halves, then in another half hour each of these will divide into halves. By the end of the first day, at

this geometrical ratio, the original germ will have over 16,500,000,000 descendants.

Bacteria are children of darkness and dampness. They are killed by the sun, they are dried up by lack of water. Many are frozen to death. Others are starved for lack of proper food. They may live too crowded, and be killed by their own poisonous waste-substances. When subjected to unfavorable conditions, some types of them do not perish, but pass into a resting or "spore" stage, in which state some of them can be boiled for eight hours without killing them; but by boiling them on successive days, all of them can be killed, and surgical dressings and equipment can be thus rendered positively free from septic matter (i.e., made aseptic, or sterile).

When the floor of a great factory is one immense cuspidor, and no radical efforts at sputum disposal, nor effective ventilation, is entertained, every cubic foot of the atmosphere inevitably contains many myriads more bacteria than is present in the atmosphere out-of-doors. And the dust in buildings and factories that settles everywhere, likewise, is more than ordinarily infectious.

Hence the necessity of the thorough cleansing of all wounds, and the daily renewal of sterile dressings next to the granulating surface, until full recovery.

Hence the necessity of the patient co-operating

with the physician in maintaining the thorough cleanliness of the wound. It is small display of intelligence on the part of a patient, who deliberately places his unwashed finger on a wound, or in proximity to a wound, made clean by thorough washing on the part of the physician. Nor is it courteous to remove the dressings from the wound, and put on "any old thing," then disparage the physician if the results are unsatisfactory.

Hence the necessity of washing hands before eating.

Hence the necessity of a sufficient dietary, and abundant sleep to increase and maintain the natural defenses of the body against the infections that lurk in every confined atmosphere, particularly against tuberculosis. The constant breathing of fine dust lacerates the delicate lung tissues, and makes breaches through which the invading tubercle bacilli more easily enter, and more easily gain a foothold. The habitual use of alcoholic liquors likewise impairs man's vital resistance.

While heredity and environment may act as predisposing causes of disease, and while impaired general health from whatever cause is a contributing factor, yet the exciting cause in every acute disease is some form of pathogenic bacteria.

Diseases of an infectious nature are transmitted by contact with persons having such

diseases, or by using articles handled by them, such as towels, combs, hair brushes, drinking cups. Persons afflicted with an infectious disease carry millions of these bacteria. For instance, persons having pulmonary tuberculosis, in an active stage, are dangerous to the general public, but especially to those with whom they live and work. Their expectoration contains billions of tubercle bacilli. The sputum dries up and these bacteria are spread broadcast by the wind, by sweeping and dusting. As bacterial life is invisible, we are inclined to underestimate these micro-organisms; they constitute our most formidable enemy; "we are fighting an insidious foe."

By isolation and quarantine, those with infectious diseases can be separated from the healthy, by methods of sanitation and disinfection the disease-producing bacteria may be eradicated, and the incidence of infectious diseases largely prevented. But let these bacteria find lodgment in the human body, they find there the warmth, moisture and pabulum necessary for their existence and rapid propagation. Their host falls a victim to a disease—he may readily recover from it, or it may result fatally. It is a contest between the host and the parasitic invaders.

Acute and subacute diseases are practically all due to infections, and the bacteria (cocci,

bacilli and spirilla) of most of them are well understood. The conclusion is readily deducible that infectious diseases are preventible; that by the isolation of those infected, until their recovery, together with the isolation of those caring for them, the number of persons exposed to disease can be greatly reduced, and by the intelligent co-operation of all, the infectious diseases might be made to practically disappear from among men.

Tuberculosis is acquired through the respiration; it can be overcome, when the sputum of everybody is properly disposed of, and when every man reaches that plane of devotion to the public welfare that his conscience will hurt him, if he expectorates on any floor or pavement. Then the great white plague will have few new victims.

Typhoid fever and cholera are acquired through the intestines, by drinking infected water, or eating infected food. With an adequate supply of pure water in the city and on the farms, as well as all other avenues of infection under control, these and many other preventable diseases give promise of being successfully eradicated, providing proper sanitary methods are consistently instituted, and insistently maintained.

THE EFFECTS OF OCCUPATION ON HEALTH [1]

CONSERVATION OF THE BODILY RESOURCES—SUFFICIENT EXERCISE, WHOLESOME FOOD, ABUNDANT SLEEP.

A STATISTICAL study of the inroads of tuberculosis in the tenement districts of Philadelphia has revealed the fact that the disease is most prevalent among the Negroes and Italians. In the Congo region of Central Africa, tuberculosis

[1] This paper was originally presented before The Westinghouse Club of Wilkinsburg (Pittsburgh) lecture season of 1910. It was published in *Physiological Therapeutics*, September, 1911. It has been enlarged in its treatment of food and sleep at the suggestion of Mr. C. R. Dooley, of the Educational Division, W. E. & M. Co., to enhance its value as an article suitable specifically for placing in the hands of apprentices of the Electric Company.

It is so often found that men well informed on turbines, motors, generators, have been narrowly educated in the lines of their specialty, and that they fail to apply their knowledge of mechanics and chemistry to that more intricate machine, the human body. As health is our most valuable asset, and as its complete possession is essential to our full efficiency, the present chapter seems opportune.

is unknown among the Negroes; in the cotton fields of our sunny South they are comparatively exempt from the white plague. But transfer them to Philadelphia, or the slums of any other city, and they are among its easiest victims.

Similarly, the Italians, spading and hoeing in their gardens all the year round, on the slopes of Mt. Vesuvius or Mt. Ætna, are comparatively exempt from tuberculosis. But bring them to our climatically inhospitable shores, crowd them in tenements, underfeed them, and they become victims of the white plague; they succumb to the invasion of the tubercle bacillus. In both cases the change in occupation from outdoor to indoor, combined with the change of climate, is responsible for their decimation. The same is true of the American Indians. If we allow individuals to create the soil for the infection, the infection will find them.

Our American ancestors were pioneers and lived in the forests. They were farmers and lived in the great out-of-doors. We of the present generation have become urban, and the city life is a strenuous proposition for which, as a race, we are largely unprepared. The problem is: Are we becoming civilized too rapidly? The English nobility has divorced itself from manual labor for several centuries, but has supplied the need of physical exertion by manly sports—riding, cricket, polo and hockey.

Exercise

To maintain our racial integrity we are under the necessity of exerting ourselves physically. At present the employees of American industrial, commercial and financial centers are recruited from the American farms, just as labor for certain industries is supplied from Europe.

Drawing the best blood from the rural communities is a bad thing for the American farms, and is not always a good thing for the American farmer boys, even though they win success in business and professional life in the cities. In this movement to the cities, we must be sure we are not civilizing too rapidly. Hot baths, steam heat, electric lights, easy conditions of life, luxurious apartments and sumptuous living react on the individual.

There are many in our midst whose only physical exertion is walking to and from trains, yet who formerly, or occasionally, performed heavy manual labor or engaged in strenuous athletics and gymnastics. Those of us who are pursuing mental activities to our maximum limit, need to take stock now and then, and see if the balance is being maintained, if the health equilibrium is assured.

There are 500 muscles on our skeletons, weighing nearly seventy pounds, and only three pounds of brain in the human calvarium; this is adequate

anatomical justification for manual occupation rather than sedentary office work. It is this preponderance of muscles in our bodies that makes the ancient curse placed upon man a veritable blessing: "In the sweat of thy face shalt thou eat bread." And speaking of sweating, there is nothing more salutary for many of us than enough physical exertion to open our pores.

Physiologists compute that there are over 7,200,000 sweat glands, whose total length amounts to over twenty-eight miles, in the skin of an adult man. The elimination of waste by the skin exceeds in weight the total excretion from lungs, kidneys and bowels combined. It is apparent that adequate bathing is an essential aid to assure proper skin elimination. This escape of water and salts from the skin is of great importance, so much so that when perspiration is checked, as from deficient physical exertion, it throws too much work upon the intestinal and respiratory mucous membranes. The work of elimination of waste products must be attended to. When the activity of the skin is reduced, the respiratory and intestinal mucous membranes act vicariously to maintain the elimination. By doing the work of other organs in addition to their own proper functions, they are overworked.

Bearing in mind this congestive, hyperemic condition of the respiratory mucous membranes

that ever exists among those of us who do too little muscular labor, we can understand our great predisposition to "catching colds." There is this constant liability to coryza ("cold" in the head), pharyngitis ("cold" in the pharynx), laryngitis, bronchitis, post-nasal catarrh, also to extension of the catarrhal processes to the middle ear (otitis media). Of course, "catching cold" is an infection. It is "caught" as measles or any other infection is caught, yet the predisposing cause is the congested condition of the respiratory mucous membranes; given the receptive soil, the implantation of the infection is facilitated.

Similarly, with regard to disorders of the stomach and intestines, the congested mucous membranes of the intestinal canal fail in the digestive functions as a result of their being overworked. There is fermentation in the stomach; the stomach has become a fermenting vat; there are bitter eructations (belching), even vomiting at times. There may be a history of constipation, alternating with diarrhoeal attacks. Yet all this unpleasantness does not constitute a disease, it is merely a revolt of outraged nature against artificial modes of living.

Now, while a resort to drugs is beneficial at times, for relief from distressing symptoms, and the cure of certain diseases (medicines are indispensable in their place), yet when the trouble

is caused by an inactive skin, and this by torpor of the muscular system, the wise physician will treat the cause; he will instruct his patient to shovel snow, to run a lawn mower, to saw wood, or work in a gymnasium.

The starches we eat are elaborated into glycogen (animal starch) in the liver, and this glycogen, as potential muscular and heat energy, is stored up in the muscles. It deranges metabolism (the chemical processes of digestion) to have the muscular system laden with unconsumed glycogen. To those who are familiar with the chemistry of the hydrocarbons and the proteids it is necessary only to call to your remembrance the toxic by-products of incomplete oxidation.

Much of the dyspepsia of sedentary office people begins in the muscles. The incomplete oxidation of foods already ingested (taken into the body for alimentation) has so poisoned the system that when more food is ingested the processes of digestion and assimilation are imperfectly performed.

Without attempting to apologize for the cold storage victuals that many restaurants and boarding houses provide, and which in themselves are at times laden with ptomaines; let it not be forgotten that the neglect of physical exercise of itself loads the human organism with the toxins of intestinal putrefaction, and these toxins, together with the toxins from the imperfect

oxidation of glycogen and proteid educts, can conspire to upset our digestive processes, even when the cook is all right and the grocer and butcher have supplied her with fresh products.

During the years of growth and adolescence physical exercise is life-giving. The farmer boy and girl herein have an advantage, since the physical stamina essential for the years of stress is largely acquired in early life. Moreover, without attention to muscular work, growing children and sedentary women develop a liability to various functional digestive derangements, and miscellaneous reflex systemic disturbances.

For men just out of college, who have been active in football and gymnastics, it is especially harmful to entirely neglect all manner of physical exercise, just as it is so often suicidal for a business man or farmer to retire suddenly from all mental and physical effort, to a life of ease.

But why is it harmful? What does it do to the athlete? The systematic heavy exertion required in athletics increases the size of the heart. The musculature of the heart enlarges in the number of muscular fibers, as well as in the size of each individual fiber. The blood supply is increased in the new demands made for the nutrition of the greater bulk of its muscular elements.

Now let the athletic labors of the individual suddenly terminate; what will happen? There is an end to the heavy demands made upon the

heart, and the heart atrophies (diminishes in size). Its musculature is to some degree replaced with fatty and fibrous elements, and its muscular tone is impaired. To ex-athletes, and to middle-aged men who in their early years did heavy manual labor, the advice to continue physical exercise is timely. When such persons contract acute infections, such as pneumonia or typhoid fever, they often are the victims of heart failure. Their mode of life makes them more susceptible to the invasion; then comes the pneumococcus or the typhoid bacillus as the exciting cause, and their damaged hearts make them easier victims of the infection.

Many men, even before they are thirty, have lived long enough to know from their own experience that the aches and pains with which they wake up in the mornings, and which have come to their joints and muscles when long in one position or attitude, will fade away when they exert themselves in the activities of the day.

There is much so-called rheumatism that is nothing more than faulty metabolism, that is, there exists some perversion of chemical processes in the human organism. Exertion will prove a cure for grippy colds of this origin. Yet active, athletic exercise is harmful in the incipiency of every acute disease, as diphtheria, pneumonia, etc. However, you have my point,

namely, that in a selected group of cases, a five-mile walk is the medicine required.

A case to the point is this: A certain overweight, gouty and rheumatic individual goes trout fishing when he gets an attack of rheumatism. The first few hours he is out his joints and muscles are painful to him, but as he shoves along his corpulent frame, now bathed in health-giving perspiration, he wades the mountain streams; in the joy of the chase he forgets that his feet are wet, and returns home after a few days with his rheumatism cured.

Now, this being relatively true, what are we going to do about it? Will we allow our occupation to impair our health, or will we join the "back to the soil" movement? Will we counteract by systematic physical exercise the baneful effect upon our health exerted by our several occupations, or will we continue to neglect the physical man?

The average tenure of life is increasing each decade. Men in the mental occupations live longer than those who neglect the cultivation of the mind; poets, philosophers, ministers, are noted for longevity, despite their frequent neglect of physical exercise. A few weeks of roughing it in the wilds will antidote the tedium of many months for the man who is able to relax, and who maintains the stamina for some physical exercise.

Surely, in spite of our occupations, we can hope to maintain the standard of our health and efficiency as we pursue our favored careers, if we scrupulously avoid dissipation of every type, and live prudently. Much of the outcry against unhealthful occupations is due to faulty hygiene, improper diet and irregular hours of eating and sleeping. Our habitual health is largely what we make it. Excluding the deleterious possibilities of the dust and fumes incident to some trades, and the deficient ventilation of most homes, stores, offices and factories, it matters little what our occupations may be. The maintenance of our health is largely in our own hands, and our physical salvation must be worked out in conformity with hygienic laws.

Food

A noted physiologist, in giving a definition of life, has said that life is digestion. All animal and plant life that cannot digest its appropriate food will speedily die, or is already dead.

A man requires food of three classes, namely: proteids, fats and carbohydrates.

Familiar examples of proteids are lean meats, white of eggs and beans. Proteids are rich in nitrogen, and are the tissue builders. Proteid food is more essential during the period of growth than at other periods of life, and more required by those in laborious occupations than by others.

Well-known fats are butter, lard and the fatty portions of meats. Much of the fat we eat is stored in the body as potential energy for periods of emergency. Some is used as insulation in the nerve and brain structures. It is also a chief source of muscular and brain energy and heat production. It is estimated that the fats we eat furnish fully 85 per cent of the energy of our bodies. The fats of beef, pork, lamb, fowls, indeed all the fat of the meat should be eaten. The extensive use of fats increases the bodily resistance against infectious diseases, and likewise increases the physical and mental endurance. When we eat fats there is less energy wasted than in any other food we consume. Starch globules and muscle fibers will be found in a microscopic examination of the excretions of the bowels (the feces), but the fat we eat is practically all absorbed and utilized.

Carbohydrates include sugars, starches, rice, tapioca, and others. The complex molecule of the starches and sugars is broken into glucose, or grape sugar, and glycogen, sometimes called animal starch. The glycogen is formed from glucose and other substances, and is stored in the muscles; it is diminished in amount by muscular activity and may be made to disappear altogether, as under electrical stimulation, or in an animal poisoned with strychnin.

We must eat abundantly of all three types of

foodstuffs, to maintain the wear and tear, furnish heat, supply energy and provide for growth. Dietary fads are always deplorable. We need well-cooked vegetables to provide bulk, as proteids and fats alone (contained in meat diet) are too concentrated. The Esquimo eats strips of blubber (pure fat); we need more fats and starches in winter, more fruits and vegetables in summer. The seasons, the climate, our several occupations, our diverse tastes and preferences, should guide us in the matter of our diet, if our instincts have not been irrecoverably perverted.

All the vegetables, nuts, fruits, and cereals contain elements to some extent necessary to maintain the proper balance of the constituent elements of the human body in their right proportion. An excess of any wholesome food may bring satiety, even loathing; on the other hand, any deficiency of needed elements will ordinarily develop an appetite for a certain article of food, or class of foods, which will abate as the equilibrium is again restored. The tissue-balance is best maintained by great variety in diet. As is well known, with the advent of apples, potatoes, lemons, such diseases as scurvy have disappeared.

An elaborate menu, with many varieties of food every meal, tempting the palate to excessive indulgence, is unfortunate. Habitual overeating is one of the factors in producing aterio-

sclerosis (hardening of the arteries), that dread precursor of premature old age. Less proteids (not more than one kind of meat at a meal), more fruits, vegetables, cereals, will afford this needed variety, and the required bulk, without inducing early degenerative changes in the arteries. "A man is as old as his arteries."

We require much food for maintaining the full efficiency of the human machine, just as a great deal of fuel is required when keeping a full head of steam in a boiler. Some foods are well balanced and supply all the types of food; milk is a perfect food, containing proteid, fat and sugar in nearly ideal proportions. It is the food for the infancy of all animals from the ant to the elephant. Fat meat and potatoes is a perfect combination; so is bread and butter and eggs; and similarly macaroni, butter and cheese combine admirably. In fact, we are quite scientific in most of our dietary combinations without expending much thought about it, if only our normal healthy appetites remain unperverted.

When food has been taken into our stomach we say it has been ingested; when it has been carried off from the stomach into the intestines, acted upon by the digestive juices and ferments and liquefied for its absorption, it is said to be digested; when it has been carried off by the blood and lymph vessels, ready for appropriation

by the cells forming the various organs and tissues of our bodies, then the food has been assimilated. These chemical processes, in splitting up food elements and recombining them into suitable compounds, and the oxidation processes by which we derive our energy and heat are collectively known as metabolism. Metabolism may also be defined as the power possessed by animal and plant life, that enables it to use up new material (constructive metabolism) and that enables it to throw off effete material (destructive metabolism), enabling the living body to grow, and to renew and prolong its life, by molecular changes constantly taking place in the condition of its cells.

The close analogy between the steam engine and the human machine is familiar to all. In the transformation of energy the human machine is much more efficient. The steam engine depends upon the burning of coal (oxidation) for the development of its heat and energy. The human machine requires foodstuffs. In both there is no production, simply a transformation of energy. The potential energy of the coal was stored up by the sun in primeval vegetation millions of years ago, to be set free by the burning of the coal. The potential energy of our foods, directly or indirectly of vegetable origin, has been stored up by the sun, and is released by oxidation at low temperature (under 100° F.) in

our tissues. The products are moreover similar whether the food is slowly burned in the muscles and other tissues of the body, or rapidly burned in the fire of a furnace, except in the case of proteids (nitrogenous substances), which are less completely burned up in the body, the nitrogen being given off in the form of urea and related bodies. In the furnace this urea can be further oxidized into nitrogen gas, carbon dioxide, and water. Fats, sugars and starches are completely burned up (oxidized) in the human body; their end-products are water and carbon dioxide. Such chemical changes, as stated before, constitute one phase of metabolism.

The carbon dioxide we eliminate with our expired air; the water, urea, many inorganic salts and certain other products are excreted by the kidneys. The feces contain the unappropriated food, and miscellaneous effete substances. Water, certain salts and ethereal bodies escape by the skin.

Fatigue

Fatigue is largely due to an accumulation of the waste substances produced by muscular activity. The fatigue subsides when a period of rest intervenes, permitting of the excretion and elimination of these waste substances. The true restoratives for fatigue are found in pure

water and wholesome food, rather than in drugs and alcoholic beverages. Training to a great degree relieves fatigue; work and exertion become easier, through the accustoming of the heart and respiratory centers to greater quantities of fatigue products. Through improvement in our muscles by increasing their bulk, strength and dexterity, our exertions produce a diminished quantity of the waste products of fatigue. And simultaneously there is evolved an increased capacity of the heart for handling the greater blood stream and of the lungs for eliminating the increased carbon dioxide; there is effected a general improvement in the other avenues of elimination of the waste substances due to fatigue, namely, the skin, the intestines and the kidneys.

That there is a definite production of such waste substances, and that these waste substances of fatigue accumulate more rapidly than they can be removed, is capable of physiological proof. A dog is thoroughly tired out by running. The blood of the tired dog is now injected into the veins of a perfectly rested dog, when the latter exhibits all the symptoms of fatigue.

Similarly, the massage of fatigued muscles, kneading out of the muscular fibers into the blood and lymph channels this excess of waste products, lessens the sense of fatigue. The flow

of a properly selected electric current will likewise relieve fatigue.

In order to maintain our efficiency, we moreover require some relaxation and recreation, but above all we need long hours of sleep.

Sleep

Sleep is a reparative, recuperative process; it is produced by the benumbing effects of the waste products of activity upon the cells of those areas of the brain-cortex that preside over the senses. Sleep is also invited by excluding sensory stimuli, especially light and sound. By sleeping in a cool well-ventilated room, on a firm mattress, adequately covered, but not excessively weighted with bed clothing, sleep is favored. A moderately hot bath before retiring is found by many to promote sleep, as does eating in moderation before retiring; the gnawing of a hungry stomach drives away sleep. Furthermore, one of the best methods of depleting the blood vessels of the brain is to divert the blood current to the abdomen by means of food. Other modes of equalizing the circulation suggest themselves. If there has been too little physical exertion, a short walk in the open air, or light gymnastics, yet avoiding excessive fatigue, promotes sleep. A person can be too exhausted to sleep well; over-exertion and under-exertion are alike inimical

to sleep. Changing during the evening from a heavy study to light literature, or to games and other diversions, may be conducive to sleep. A personal study of one's individual case is always preferable to an habitual resort to hypnotic drugs. We cannot always sleep instantly on retiring; there is vasomotor relaxation during such rest in bed that is nearly as refreshing as sleep. Deep regular breathing upon retiring assists some persons in getting to sleep. In sleep there is a diminished rate of respiration, the heart beats about eight times less each minute, and the blood pressure in the brain is lowered. Sleep is nature's sweet restorer, but to be perfect, no sensory impulses should reach the higher brain centers; the activities of the day likewise must be dismissed from consciousness, the planning and the troubles of the present, past and future, should not be reviewed when we recline upon our couches at the end of the day.

Ordinary pains and aches, as neuralgia and toothache, even injuries, as contusions, or a foreign body in the eye, are reported merely to subconsciousness while the mind is alert and the body tuned up to its full measure of activity, during the busy hours of the day. When we retire for sleep, and relax every fiber of our bodies, and disassociate every line of thought, and free ourselves from sense stimuli (as noise and light) as much as possible, then these sub-

conscious states may emerge to the field of consciousness, and exert a disquieting influence, destructive to sleep. These sensations are admonitions, and warn us of defects and functional derangements that require attention. The cause must be found and removed. The dentist, the surgeon, the physician may be advantageously consulted. "Make your repairs before the machine breaks down."

Physical and mental states may be conducive to sleep, yet introspective analysis of life and conduct may destroy sleep. Without entering the realm of the metaphysical, it is nevertheless proper to mention in this connection that integrity of life, honor, honesty, virtue, purity, "a conscience void of offense," ability to look the whole world in the face, induces an equanimity favorable to sleep, and, despite fleeting years, helps maintain the vigor of youth to a ripe age.

A normal, healthy man in a quiet room will ordinarily sleep eight hours. Regular hours of sleep are highly desirable. The night is the proper time for sleep. As the number of hours of sleep required in advancing life varies with each individual, the determination of how many hours are essential to each of us must remain a personal matter. Yet seven hours in bed is too little for many brain and muscle workers. During the years of their rapid growth, children require much more sleep; they eat proportion-

ately more than adults, and as they do not appropriate in tissue-building nearly all the food they assimilate, they too have waste products to eliminate. During natural sleep such elimination is much facilitated. Sleep is more refreshing when there is an abundance of fresh air in the sleeping apartments. Windows are made to be opened. During the day our activities carry us in and out, and we get much fresh air, but at night especially we need an abundance of fresh air, air rich in oxygen, in our bedrooms. This assures to the wearied brain and tired body refreshing sleep, and provides for the blood, impoverished by the day's exertions, sufficient oxygen to maintain the haemoglobin (the iron-containing proteid of the red corpuscles) at the full 100 per cent standard of health. Thus can we hope, in spite of our occupations, to counteract their deleterious tendencies; and we can maintain such a degree of health as will enable us to resist infections, and can maintain that degree of buoyancy and resiliency that will make life a joy and our routine duties a pleasure.

QUESTIONS ON ELECTRICAL INJURIES[1]

1. What is meant by an electrical flash?
2. What is the effect of a flash on the eyes?
3. What is the effect of a flash on the skin?
4. What is likely to occur in opening a switch carrying a heavy current of electricity?
5. Can a flash injury occur without the person coming in immediate contact with an electric current?
6. Why does a person very seldom make contact with a circuit of 15,000 volts or over?
7. What parts of the body are most usually affected by an electrical discharge?
8. What is the extent of injury in a second degree burn?
9. What is a third degree burn?
10. What precaution should be taken when working around, or looking at an electric welding machine in operation?
11. Can a burn from an electric arc occur when the person is too far away to feel any heat?
12. How long a time may elapse before an electric burn becomes noticeable?

[1] The author tenders special acknowledgements to R. J. Watson, of the Casino Technical Night School, for assistance in compiling the ensuing questions.

13. What is conjunctivitis? What is the best single remedy in its treatment?

14. What is the first consideration in the treatment of every electrical burn?

15. What is infection?

16. What is the cause and what are the symptoms of infection?

17. What dressings should a burn receive after it has been thoroughly cleansed?

18. Should blebs or water blisters be opened? Why?

19. Describe the effect of a flash from high voltages?

20. What are the visible marks of a high voltage flash?

21. Is fright ever a fatal factor to a person receiving an electrical shock?

22. What amperage of current is used in criminal electrocutions?

23. Which is the better conductor, oil or salt water?

24. Which is the better conductor of electricity, nerve tissue or the blood? Why?

25. Describe the effect of a heavy electric current on the following organs as determined by post-mortem examination at criminal executions—heart, lungs, nerves, capillaries, blood and muscles.

26. What is the color of the blood when death has been caused by an electrical shock? Why?

27. Does the blood coagulate when death has been produced by electrical shock? Why?

28. What is metabolism?

29. What is asphyxiation?

30. What is anaemia?

31. Describe the three theories advanced regarding death due to electrical shock.

32. What precautions should be taken by the person or persons who go to the rescue of one who has received an electrical shock?

33. What is resuscitation?

34. What is the first thing to be done after the patient has been released from the electrical contact?

35. In what position should the patient be laid?

36. What position should the operator assume?

37. Describe the motions to be performed by the operator?

38. What should be the length of time in making the downward pressure?

39. What part of the patient's body should receive the weight of the operator?

40. What part of the hand of the operator should press on the patient?

41. Should the operator's arms be rigid and straight or should they be bent and flexible?

42. How rapidly should the operator work?

43. How long should work be continued on patient before concluding that life is extinct?

44. Who should determine whether or not continued effort at resuscitation would be futile?

45. Should the patient be given any liquid stimulant before breathing has been established?

46. What would you give, by inhalation, as a stimulant to breathing?

47. What assistance can be rendered by the person or persons assisting the operator?

48. How soon should the patient sit up after regaining consciousness?

49. Name five specific advantages of using the Prone Pressure method of resuscitation.

50. What are the disadvantages of laying the patient on his back during efforts at resuscitation.

51. What is the average resistance of the human skin?

52. What will increase this skin resistance?

53. What factors will lower this skin resistance?

54. Under what circumstances may 110 volts be dangerous?

55. Do the number and location of the points of contact increase the danger from the passage of the current?

56. What amperage is dangerous?

57. Why does the victim usually receive merely a leakage current and not the full voltage of the line?

58. What are the causal factors in dangerous electrical shocks?

59. Contact burns are usually of what degree?

60. Why should all electrical burns receive medical attention at once.

61. What is gangrene?

62. What is necrosis?

63. Is gangrene or necrosis ever the result of an electrical burn?

64. Why is amputation sometimes necessary when the burn appears trivial at first?

65. Does artificial respiration save life?

66. What is the usual behavior of persons witnessing an electrical shock?

67. What should be the actions of those witnessing an electrical shock?

68. Is ignorance ever criminal negligence?

69. What various means can be employed in rescuing a comrade from a high-voltage circuit without endangering the rescuer?

QUESTIONS ON MINOR SURGERY

1. What is the difference between an incised wound, a lacerated wound and a puncture wound?

2. What are the first signs that a wound has become infected?

3. What simple treatment should be given a small wound to insure it against infection?

4. In case muscles, tendons or nerves are cut through, how is complete recovery of function secured?

5. How are surgical dressings made aseptic?

6. What do you mean by aseptic?

7. If blood is flowing from a wound in what two ways could you distinguish whether the hemorrhage is arterial or venous?

8. If the wound is bleeding in spurts, where would you apply the bandage?

9. What is a fracture?

10. What is a compound fracture?

11. What is the best way to restore a fainting person?

QUESTIONS ON INFECTION

1. What is wound infection?
2. What is an infectious disease?
3. What are bacteria?
4. Are they all injurious to man?
5. Are they classed as animal or as vegetable micro-organisms?
6. Under what conditions are bacteria most readily developed?
7. How may bacteria be killed?
8. Does spitting on the floor or sidewalk endanger health, and why?
9. Why should the hands be washed before eating?
10. What effect does an insufficient amount of sleep and food have upon the body?
11. What are predisposing causes of disease? What is the exciting cause?
12. What is tuberculosis and how is it acquired?
13. What are some of the precautions taken to avoid infection by tuberculosis?
14. What are some of the ways in which infectious diseases are spread?
15. How are typhoid fever and cholera acquired?
16. How can infectious diseases be eradicated?

QUESTIONS ON HEALTH AND OCCUPATION

1. Does the occupation have any determining effect upon the health of the individual?

2. Why is the present generation subject in a greater degree to tuberculosis than their ancestors?

3. Why should a definite part of the day be given to physical exercise, especially on the part of those in sedentary occupations?

4. What are the beneficial results to be derived from perspiring freely?

5. Does the skin carry off any waste matter?

6. What is the effect on the other organs when the skin does not perform its proper function?

7. Is a "cold in the head" contagious?

8. Why do we "catch cold"?

9. What predisposes us to "catching cold"?

10. Is a resort to drugs necessary every time we feel out of condition?

11. Should a man be his own physician?

12. In what way does deficient exercise disturb our digestion and assimilation?

13. Why is a business man's or a farmer's life often shortened by retiring from active business?

14. How do athletics develop the heart? Does heavy labor in early life tend to longevity?

15. The outcry against unhealthful occupations should as a rule be charged to what?

16. Name the three classes of foods required by the human body.

17. Name some of the proteids.

18. What purpose do they serve?

19. In what period of life are proteids most needed?

20. What is the use of fat to the human body?

21. Name some of the carbohydrates.

22. What purposes do they serve?

23. Why is variety in diet advantageous?

24. What is the best guide to our diet?

25. In what way does over-eating prove injurious?

26. What is ingestion?

27. What is digestion?

28. What is assimilation?

29. What is metabolism?

30. What is oxidation?

31. Name the chief end products of complete oxidation.

32. Is there any difference between the fuel consumed in a steam engine and the food consumed in the body? Trace the analogy.

33. What is the function of the kidneys?

34. What is the cause of fatigue?

35. In what three ways does training diminish fatigue?

36. What is the best cure for fatigue?

37. What is elimination?

38. What is rest? Is inactivity rest?

39. What proofs have we that fatigue products accumulate in the body?

40. What is sleep?

41. What produces sleep?

42. Of what use is sleep?

43. Do all persons need the same amount of sleep?

44. How many hours of sleep are needed by the normal man?

45. Should a person go to bed hungry?

46. Enumerate six factors conducive to natural sleep.

47. Under what conditions is sleep most favorable?

48. Why do children require more sleep than adults?

49. Does regularity of habits have anything to do with the general health of the individual?

50 nu